Toys That Fly Treasure Hunt

Introduction

One purpose of this treasure hunt is to introduce you to the physics of flight by considering how various forces act on flying toys such as frisbees, boomerangs, flying rings, and the like, but NOT rockets (why not?). The Toys That Fly Hotlist should have enabled you to find an interesting toy for you to investigate, but YOU will have to decide how the general principles of flight apply to your toy – that is, what keeps it in the air? The ultimate purpose of this activity is to honor the triumph of the Wright brothers 100 years ago and the flying toy that inspired them. Who says playing with toys is a waste of time?

First go to the Toys That Fly Hotlist and select a flying toy. Next comes some basics about the forces of flight – remember, you're going to have to figure out how these forces work on your toy – always keep that in the back (or front!) of your mind as you surf these sites. Take notes! If there's a link to an activity that might help you understand the concept under discussion, by all means explore it! Remember to record the URLs of any other sites you visit during your investigations. Finally, somehow you will have to communicate what you have learned – ask your teacher.

The Challenge

I. Basic Information on the Forces of Flight

1. What are the forces that affect flight?
http://www.grc.nasa.gov/WWW/K-12/airplane/forces.html
http://www.allstar.fiu.edu/aero/forcesactairflght.htm

2. How do atmospheric conditions affect flight? (Will a windy day affect your toy? How about the air temperature – does it make any difference?)
http://www.allstar.fiu.edu/aero/flight20.htm

3. What is drag and what affects it? (How does the shape of your toy affect its flight?)
http://www.grc.nasa.gov/WWW/K-12/airplane/drag1.html

4. What is Bernoulli's Principle and how does it apply to flight? (Does Bernoulli's Principle affect your toy?)
http://www.allstar.fiu.edu/aero/pic3%2D2.htm

5. What is the controversy between Bernoulli's Principle and the so-called "Newtonian" model of flight? Who's "right"? (Scientists and engineers often disagree with one another – how do they resolve these conflicts?)
http://www.turnertoys.com/G1/aeroScience/default.htm
http://www.grc.nasa.gov/WWW/K-12/airplane/bernnew.html
http://www.aa.washington.edu/faculty/eberhardt/lift.htm

6. How can planes fly upside down? (Can your toy fly upside down? Why or why not?)
http://www.turnertoys.com/G1/aeroScience/default.htm

7. Why does air flow faster over the top of an airfoil? How does the shape of an airfoil affect flight? (Where is the airfoil on your toy? What is its shape in cross-section?)
http://www.grc.nasa.gov/WWW/K-12/airplane/wrong2.html

8. What is the Coanda effect? (Does this effect affect your toy? How?)
http://www.aa.washington.edu/faculty/eberhardt/lift.htm

9. What keeps flying craft stable as they fly (especially "thrown" toys)? (This is one of the most important questions of all!)
http://quest.arc.nasa.gov/aero/wright/teachers/pitch/activity.html

10. What are pitch, roll, and yaw? (How are these controlled for on your toy?)
http://www.grc.nasa.gov/WWW/Wright/airplane/pitch.html
http://www.grc.nasa.gov/WWW/Wright/airplane/roll.html
http://www.grc.nasa.gov/WWW/Wright/airplane/yaw.html

Hey! It wouldn't hurt to go get or make a version of your toy and do a little experimenting. Can you connect what you've seen and read to the flying behavior of your toy? Maybe somebody you know has an air tunnel – try experimenting with models of your toy's airfoil.

II. The Toy That Started it All

11. What toy inspired the Wright brothers and who invented it? What happened to this inventor?
http://www.uh.edu/engines/epi1489.htm
http://aerostories.free.fr/precurseurs/penaud/page2.html

12. What does the toy look like and how does it work? (How does it compare to your toy?)
http://www.uh.edu/engines/epi1489.htm
http://aerostories.free.fr/precurseurs/penaud/page2.html

III. Focus on Toys

13. What are the sources of thrust for flying toys? How do they get into and stay in the air?
http://explore4fun.com/flying.html

14. What are the differences between powered and un-powered flying craft? (Which applies to your toy?)
http://www.grc.nasa.gov/WWW/K-12/airplane/glider.html

*15. Probably the first thing you have to do is to determine the nature of your toy's airfoil. To get you started, here's a short paper on this problem faced by one flying toy inventor.
http://www.aerobie.com/aerobie.htm

Now put it all together into a coherent description, maybe even a nice presentation.

IV. Star Wars Lies! Extend What You Have Learned!

16. How do spacecraft "fly" in outer space if there's no atmosphere? What's wrong with EVERY commercial sci-fi depiction of space travel? (Hint: how does a real spacecraft change direction?) You might want to start by investigating the attitude control system for a real spacecraft, say like, oh I don't know, maybe the SPACE SHUTTLE!?!?

Notes to the Educator/Parent

More challenging activities are indicated by an asterisk. Some of the sites have rather long text passages. In these cases it is reasonable to use the "Find" function in the Edit menu to search for the word or phrase of interest, though you may well skip by some fascinating information if you do.

Standards

The activities in this treasure hunt are most closely aligned with the following standards at the middle and high school levels:

I. The National Science Education Standards (for grades 5-8 and 9-12) available at:
http://books.nap.edu/html/nses/html/index.html

Content Standard A – Science as Inquiry
Content Standard B – Physical Science: Motions and Forces
Content Standard E – Science and Technology: Abilities of Technological Design
Content Standard G – History and Nature of Science: History of Science, Nature of Science, Science as a Human Endeavor

II. Project 2061 *Benchmarks for Science Literacy* (for grades 6-8 and 9-12) available at:
http://www.project2061.org/tools/benchol/bolframe.htm

Benchmark 1 – The Nature of Science
B. Scientific Inquiry
C. The Scientific Enterprise

Benchmark 3 – The Nature of Technology

A. Technology and Science
B. Design and Systems

Benchmark 4 – The Physical Setting

F. Motion
G. Forces of Nature